More carbon in soil can control weeds, in some cases

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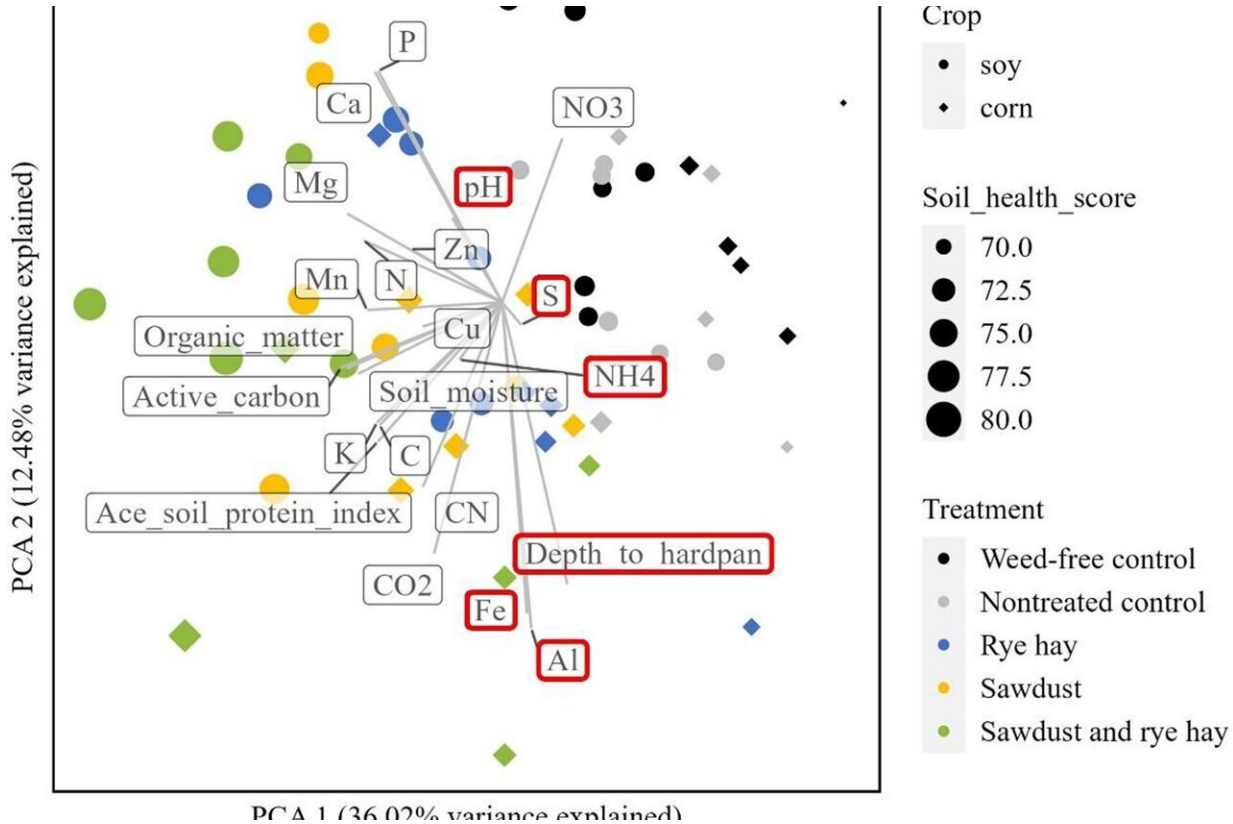

(A) Average soil health ratings for each plot treated with different amendments. Box plots labeled with different letters indicate significantly different means (P Weed Science (2024). DOI: 10.1017/wsc.2024.17

Cornell researchers have tested an ecological tool in the fight to control weeds in silage soybean and corn fields: adding carbon to soil in the

form of sawdust and rye hay.

The study found that sawdust controlled weeds well in soybean fields but not as well in corn fields. Sawdust offers an eco-friendly alternative to conventional methods for controlling weeds, such as tilling and herbicides, each of which have their own downsides.

"Growers have been trying different herbicides and plants have developed resistance to them, and then growers don't have many options," said Jenny Kao-Kniffin, professor in the School of Integrative Plant Science Horticulture Section in the College of Agriculture and Life Sciences, and senior author of a 2024 study in the journal *Weed Science*.

Another issue is that companies are not developing new herbicides, she said. Meanwhile, tillage comes with its own problems: it disrupts soil structure, which can lead to soil erosion. Also, weeds can evolve strategies against tillage by growing throughout the season.

"But there are other ways to manage weeds that are based on general principles of soil biology," Kao-Kniffin said. "Adding carbon to soil triggers a cascade of microbial processes that can work in favor of weed management, if it's applied at the right time."

"There's been less emphasis on ecological weed management practices than on tillage and chemical weed management," said Maria Gannett, Ph.D. '23, the paper's first author who is currently a weeds extension educator at the University of Massachusetts, Amherst. "This was one strategy where we were diving a little deeper into the interactions between microbes and weeds and crops."

Soil microorganisms are the key to suppressing weeds when adding carbon, because they eat carbon and use it to grow, and when they do, they scavenge more for nitrogen, which plants need to grow. By

immobilizing nitrogen, and keeping it from plants, microbes can help suppress weeds.

In the study, the researchers ran experiments in 2020 and 2021 with different treatments on soybean and corn fields. These included adding carbon in the forms of sawdust or rye hay, and two controls where plots were weeded by hand or were completely left alone.

"We found effects on the microbial community, the weed community and then also on crop growth," Gannett said.

As one might expect, both weed management and crop growth were among the best in the control plots that were weeded by hand.

"That's the gold standard," even if it isn't practical for growers, Gannett said.

In soybean plots, the addition of sawdust to the soil resulted in almost no weed growth. Sawdust treatments also led to the second highest soybean growth, maybe because soy fixes its own nitrogen.

In contrast, the addition of rye hay resulted in the most weed growth, likely because the hay contains its own nitrogen. And by 2021 the soybeans didn't grow as well, as weeds seemed to have outcompeted the crop.

With corn, the sawdust treatment inhibited weed growth, but not quite as dramatically as with the soybeans. That could have been because the researchers fertilized the corn since corn can't fix its own nitrogen; the addition of nitrogen may have led to more weed growth in the corn field than with the soybeans, Gannett said.

Like in the soybean plots, the addition of rye hay resulted in the greatest

weed growth in corn fields—but it also led to the highest crop growth—or biomass—in corn in 2020. This result could be because of the nitrogen in rye, which corn thrives on.

In terms of microbes, both sawdust and rye hay treatments led to the most growth (measured by respiration levels) in both corn and soybean fields.

"Farmers can time things so that the soil is very rich in carbon at a time when target weeds are germinating," Kao-Kniffin said.

Co-authors include Antonio DiTomasso, professor and section head in the School of Integrative Plant Science Soil and Crop Sciences Section in CALS, Jed Sparks, professor and chairperson in the Department of Ecology and Evolutionary Biology in the College of Arts and Sciences, and Aleah Butler-Jones, doctoral student in the Horticulture Section of the School of Integrative Plant Sciences.

More information: Maria A. Gannett et al, Soil C:N impacts on soil biological health and consequences on weed control in soybean and corn systems, *Weed Science* (2024). DOI: 10.1017/wsc.2024.17

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